

**UTILITY
PATENT APPLICATION
TRANSMITTAL**

(Only for new nonprovisional applications under 37 CFR 1.53(b))

Attorney Docket No.

109289.00121

First Inventor or Application Identifier

M. Alperovich

Title

Method of Increasing Fluorescent Signal of Optical Disks with Fluorescent Reading

APPLICATION ELEMENTS

See MPEP chapter 600 concerning utility patent application contents

ADDRESS TO: Assistant Commissioner for Patents
Box Patent Application
Washington, DC 20231

- ☐ Fee Transmittal Form (e.g. PTO/SB/17)
(Submit an original and a duplicate for fee processing)

2. ☒ Specification

Total Pages

19

3. ☐ Drawing(s) (35 U.S.C. 113) Total Sheets

4. ☐ Oath or Declaration

Total Pages

a. ☐ Newly executed (original or copy)

b. ☐ Copy from a prior application (37 C.F.R. §1.63(d))
(for continuation/divisional with box 15 completed)

i. ☐ **DELETION OF INVENTOR(S)**

Signed statement attached deleting inventor(s) named
in the prior application, see 37 C.F.R. §1.63(d)(2) and
1.33(b).

5. ☐ **Incorporation By Reference** (usable if box 4B is checked)

The entire disclosure of the prior application, from which a copy of the
oath or declaration is supplied under Box 4B, is considered to be part
of the disclosure of the accompanying application and is hereby
incorporated by reference therein.

ACCOMPANYING APPLICATION PARTS

6. ☐ Assignment Papers (cover sheet & document(s))

7. ☐ 37 C.F.R. §3.73(b) Statement ☐ Power of Attorney
(when there is an assignee)

8. ☐ English Translation Document (if applicable)

9. ☐ Information Disclosure Statement (IDS)/PTO-1449 ☐ Copies of IDS Citations

10. ☐ Preliminary Amendment

11. ☒ White Advance Serial No. Postcard

12. ☐ Small Entity Statement(s) ☐ Statement filed in prior application. Status still proper and desired.

13. ☐ Certified Copy of Priority Document(s)
(if foreign priority is claimed)

14. ☐ Other:

15. If a CONTINUING APPLICATION, check appropriate box, and supply the requisite information below:

☐ Continuation ☐ Divisional ☐ Continuation-in-part (CIP) of prior application no.:

Prior application information: Examiner:

Group Art Unit:

16. Amend the specification by inserting before the first line the sentence:

☐ This application is a ☐ Continuation ☐ Division ☐ Continuation-in-part (CIP)
of application Serial No. Filed on

☒ This application claims priority of provisional application Serial No. 60/119,899 Filed February 12, 1999

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項目	1990年	1991年	1992年	1993年	1994年	1995年	1996年	1997年	1998年	1999年	2000年	2001年	2002年	2003年	2004年	2005年	2006年	2007年	2008年	2009年	2010年	2011年	2012年	2013年	2014年	2015年	2016年	2017年	2018年	2019年	2020年	2021年	2022年	2023年	2024年	2025年	2026年	2027年	2028年	2029年	2030年	2031年	2032年	2033年	2034年	2035年	2036年	2037年	2038年	2039年	2040年	2041年	2042年	2043年	2044年	2045年	2046年	2047年	2048年	2049年	2050年	2051年	2052年	2053年	2054年	2055年	2056年	2057年	2058年	2059年	2060年	2061年	2062年	2063年	2064年	2065年	2066年	2067年	2068年	2069年	2070年	2071年	2072年	2073年	2074年	2075年	2076年	2077年	2078年	2079年	2080年	2081年	2082年	2083年	2084年	2085年	2086年	2087年	2088年	2089年	2090年	2091年	2092年	2093年	2094年	2095年	2096年	2097年	2098年	2099年	2100年	2101年	2102年	2103年	2104年	2105年	2106年	2107年	2108年	2109年	2110年	2111年	2112年	2113年	2114年	2115年	2116年	2117年	2118年	2119年	2120年	2121年	2122年	2123年	2124年	2125年	2126年	2127年	2128年	2129年	2130年	2131年	2132年	2133年	2134年	2135年	2136年	2137年	2138年	2139年	2140年	2141年	2142年	2143年	2144年	2145年	2146年	2147年	2148年	2149年	2150年	2151年	2152年	2153年	2154年	2155年	2156年	2157年	2158年	2159年	2160年	2161年	2162年	2163年	2164年	2165年	2166年	2167年	2168年	2169年	2170年	2171年	2172年	2173年	2174年	2175年	2176年	2177年	2178年	2179年	2180年	2181年	2182年	2183年	2184年	2185年	2186年	2187年	2188年	2189年	2190年	2191年	2192年	2193年	2194年	2195年	2196年	2197年	2198年	2199年	2200年	2201年	2202年	2203年	2204年	2205年	2206年	2207年	2208年	2209年	2210年	2211年	2212年	2213年	2214年	2215年	2216年	2217年	2218年	2219年	2220年	2221年	2222年	2223年	2224年	2225年	2226年	2227年	2228年	2229年	2230年	2231年	2232年	2233年	2234年	2235年	2236年	2237年	2238年	2239年	2240年	2241年	2242年	2243年	2244年	2245年	2246年	2247年	2248年	2249年	2250年	2251年	2252年	2253年	2254年	2255年	2256年	2257年	2258年	2259年	2260年	2261年	2262年	2263年	2264年	2265年	2266年	2267年	2268年	2269年	2270年	2271年	2272年	2273年	2274年	2275年	2276年	2277年	2278年	2279年	2280年	2281年	2282年	2283年	2284年	2285年	2286年	2287年	2288年	2289年	2290年	2291年	2292年	2293年	2294年	2295年	2296年	2297年	2298年	2299年	2300年	2301年	2302年	2303年	2304年	2305年	2306年	2307年	2308年	2309年	2310年	2311年	2312年	2313年	2314年	2315年	2316年	2317年	2318年	2319年	2320年	2321年	2322年	2323年	2324年	2325年	2326年	2327年	2328年	2329年	2330年	2331年	2332年	2333年	2334年	2335年	2336年	2337年	2338年	2339年	2340年	2341年	2342年	2343年	2344年	2345年	2346年	2347年	2348年	2349年	2350年	2351年	2352年	2353年	2354年	2355年	2356年	2357年	2358年	2359年	2360年	2361年	2362年	2363年	2364年	2365年	2366年	2367年	2368年	2369年	2370年	2371年	2372年	2373年	2374年	2375年	2376年	2377年	2378年	2379年	2380年	2381年	2382年	2383年	2384年	2385年	2386年	2387年	2388年	2389年	2390年	2391年	2392年	2393年	2394年	2395年	2396年	2397年</
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Docket No. 109289.00121

Method of Increasing Fluorescent Signal of Optical Discs with Fluorescent Reading

Field of the Invention

5 The present Invention is in the field of materials for optical memory carriers with high optical memory density and reading by means of fluorescence, such as CD ROM and WORM discs, and three-dimensional optical memory systems.

Background of the Invention

10 At present, digital data carriers with optical recording, storage and reading experience fast spreading. Usually, the data is recorded by local alteration of optical thickness or the active media reflection ratio, while reading takes place by phase or amplitude changes of the laser beam in the recorded spots.

 The most cheap and absolute optical carriers are CD ROM and WORM discs. However,
15 the capacity and signal/noise ratio of the existing optical discs is not enough high for the developed computers and videosystems of the new generation. Thus, there are intensive development of advanced optical memory systems with increased record density, high signal/noise ratio, increased storage and usage stability and low cost. The promising ways of increasing optical carrier capacity are:

- 20 • increased number active bits per active layer due to reduced pit length and increased number of pits;
 • multilayer disc creation.

 These ways were realized in the recently launched DVD standard, where pits are half in size, and number of layers reaches 4 - two from each side of the substrate. It allows reaching
25 GB capacity on disc.

 At the same time, future increase of active layers on disc with reading by means of reflection causes rapid rise in the system price and lowers the quality of recorded data reproduction. Thus, future increase of disc capacity is not possible. The patents JP 63,195,838 (12.08.1988); JP 02,308,439 (21.12.1990) describe reading by means of fluorescence. The
30 principle idea is that after recording the recorded spots are non-fluorescent, and the background is fluorescent. At reading, the relevant laser beam excites fluorescent light, which is registered on the detector.

 The above patents describe single-layer optical discs with laser recording, i.e. of WORM type.

At the same time, the main advantage of fluorescent reading is in its most suitability for three-dimensional optical memory carriers, such as a multilayer disc [B. Glushko, V. Krupkin, E. Levich]

The principle construction of a multilayer optical disc with fluorescent reading is described in [B. Glushko, US Provisional Patent Application 8/05/97, N 25457].

Single-layer optical discs, where data is recorded in pit or spiral grooves, filled with fluorescent material, are laminated on each other to form a multilayer system, where active layers containing fluorescent pits or grooves with 0.5-1.0 mkm depth are separated by inactive intermediate layers of 20-50 mkm depth, transparent for the excitation laser wavelength and fluorescent light. Fluorescent media for a multilayer optical disc with fluorescent reading shall meet a range of requirements, the most important being:

1. Fluorescent media absorption range shall coincide with the reading laser wavelength.
2. Quantum yield of fluorescent media shall be the highest possible and shall stay the same during long-term storage and use.
3. Absorption and fluorescence ranges shall not overlap significantly not to cause repeated absorption of fluorescent light.
4. Fluorescent composition shall not disperse the passing excitation radiation and fluorescent light.
5. Fluorescent light shall also coincide well with the matrix and shall not migrate from it.
6. Fluorescent composition shall fill the pits or groove well and shall not tincture the space in between.
7. The solution used for filling pits or grooves shall not solve the substrate, carrying pits or grooves, or change their geometry and size.
8. Refraction ratio of the fluorescent composition shall be close to the one of the substrate, carrying pits or groove.
9. Characteristics of the fluorescent composition shall not be effected by storage or use of a multilayer optical disc.

All these requirements make it a non-trivial task to solve. It is especially difficult to achieve high intensity of fluorescence from the active layer, as if we consider it to be 100-500 nm thick, the concentration of fluorescent dye shall be equal to $3-20 \times 10^{-2}$ Mol per kg of polymer. At such concentration, the intensity of fluorescence from most of the organic luminophores will be rapidly reduced or can disappear at all due to the formation of associated forms of the dye

with sandwich structure in the polymer. Such forms are non-fluorescent and they extinguish fluorescence of monomeric forms of the dye. Ability of the dye to form dimmers and other associates is much connected to the composition and structure of the polymeric matrix, used plasticizers and other ingredients of the polymeric composition. However, such high concentrations of the dye ($3-20 \times 10^{-2}$ Mol/kg) nearly always cause formation of associates.

Recently the medias for high-density optical CD ROM and WORM discs with fluorescent reading, including multilayer discs, were described in [M. Alperovich, E. Levich, I. Zuhl, et al. US Provisional Patent Appl. N Fluorescent Composition for production of the optical memory discs of CD ROM type; M. Alperovich, E. Levich, I. Zuhl, et al. US Provisional Patent Appln. Organic dye-in-polymer (DIP) medium for WORM disks with fluorescent reading; M. Alperovich, E. Levich, I. Zuhl, et al. US Provisional Patent Appln. Optical recording medium for fluorescent WORM discs; M. Alperovich, E. Levich, I. Zuhl, et al. US Provisional Patent Appln. Optical recording medium for fluorescent WORM disk including penetrated ion pairs in organic dyes].

The proposed fluorescent compositions were used for production of CD ROM and WORM discs with fluorescent reading, including multilayer structures. The recorded digital data was read on special drives, providing registration of the fluorescent signal. At the same time, future increase of fluorescence intensity from active layers of the optical discs is needed to increase stability and quality of the read data, to simplify the construction and to lower cost of production of the reading devices for fluorescent discs. This will also allow increasing the number of active layers on multilayer discs, thus increasing the optical memory capacity.

Summary of the Invention

Taking the above into consideration, the purpose of this Invention is the development of method of increasing fluorescent signal level from the optical discs with fluorescent reading to obtain optical memory with high capacity.

The other purpose of the present Invention is the development of method of increasing fluorescent signal level from the optical discs with fluorescent reading to receive higher stability and reproduction quality, simplify the construction and to lower cost of the device for reading fluorescent signal from optical discs.

The future purpose of this Invention is the development of method of increasing fluorescent signal level from the optical discs with fluorescent reading both for single-layer and multilayer optical memory materials with high capacity and high contrast.

According to the purpose of the present Invention, the above method of increasing the fluorescent signal from optical discs with fluorescent reading assumes use in the fluorescent composition of high-molecular compounds, plasticizers and other ingredients, preventing formation of non-fluorescent dimmers and other dyes associates in the active media.

According to the other purpose of the present Invention, the above method of increasing the fluorescent signal from optical discs assumes use of a primer between the substrate and the active layer to preserve the pits or grooves on the substrate from aggressive effect of solvents, containing the fluorescent composition.

According to the future purpose of the constant Invention, the above method of increasing the fluorescent signal from optical discs assumes using in the polymer compositions of active layers the adds, improving adhesion of the active layers to the substrate or the primer.

According to the further purpose of the present Invention, the above method of increasing the fluorescent signal from optical discs assumes using in the substrate or primer the substances, providing effective absorption of non-fluorescent dimmers and other associates of the ionic pairs of cationic dyes in the active layer on the boundary between the substrate or the primer with active layer.

Detailed Description of the Preferred Embodiments

Below is the detailed description of the most preferred embodiments of the purposes of the present Invention.

First, we shall consider the variant, when the substrate - a transparent disc from polycarbonate (PC) or polymethyl methacrylate (PMMA) with pits or grooves 0.1-0.5 μm deep - is covered with a primer, which is later covered with an active layer, containing at least a fluorescent dye, film-making polymer, plasticizers and other ingredients, preventing formation of non-fluorescent dimmers and other associates of the dye, thus providing high fluorescence of the dye.

The primer is produced using different materials, providing high adhesion to polycarbonate and polymethyl methacrylate substrates, evenly distributed upon the substrate, pits

and grooves surface, forming a film 10-100 nm thick, impermeable for the solvents and other ingredients of the active layer.

Good adhesion of the active layer to the primer shall also be provided. The materials, forming the primer, can be: liquid silica glass, Colcoat N-103X product by Colcoat Co., Ltd. (Japan), polyvinyl alcohol, heat treated after depositing on the substrate, thermosetting resins, including epoxy, phenol-, urea- and melamine-formaldehyde resins, polyorganosiloxanes, as well as latexes – divinyl styrene, divinylonitrile, styrene acrylate, alkyd, acrylate, etc. The fluorescent dye of the active layer with maximum absorption near the recording laser wavelength is chosen among the xanthene dyes of the eosine and rhodamine groups, acridine, oxazine, azine, perylene, violanthrole, cyanine, phthalocyanine dyes, indigoid colors and porphyrines.

The content of fluorescent dye in the layer is 0.1-10%.

Film-forming polymer can be chosen among a wide range of resins, for example: cellulose esters, such as nitrocellulose, cellulose acetate, cellulose acetate butyrate; cellulose ethers such as methyl cellulose, ethyl cellulose, butyl cellulose; vinyl resins such as polyvinyl acetate, polyvinyl butyral, polyvinyl acetal, polyvinyl alcohol and polyvinyl pyrrolidon; acrylic resins such as polymethylmethacrylate, polybutyl acrylate, polymethacrylic acid, polyacrylic amid and polyacrylonitrile, polyvinylchloride, perchlorvinyl resin.

Film-forming properties of the used resins and the plasticity of the recording layer can be improved by adding to resins the proper plasticizer, such as dibutyl phthalate, dioctyl phthalate or tricresyl phosphate.

To create a recording layer of the present Invention, the above-mentioned ingredients are dissolved in organic solvent or introduced in it as microcapsules less than 0,2 mkm in size, prepared by known methods, with future covering the substrate with this compound by spin coating, roller coating or dip coating.

The organic solvent is usually selected from alcohols, ketones, amides, sulfoxides, ethers, esters, halogenated aliphatic hydrocarbons or aromatic solvents. Examples of such solvents include methanol, ethanol, iso-propanol, iso-butanol, tetrafluoro-ethanol, diacetone alcohol, methyl cellosolve, ethyl cellosolve, acetone, methylethylketone, cyclohexanone, N,N-dimethylformamide, N,N-dimethylacetamide, dimethylsulfoxide, tetrahydrofurane, dioxane, ethyl acetate, chloroform, methylene chloride, dichloroethane, toluene, xylene or their mixtures.

Various surface-active substances, such as butyl glycol, propylene glycol, dimethyl glycol, diethyl glycol, etc., improve adhesion of the active layers to the substrate or the primer, as well as heat the material at 100-120°C.

5 The other variant of realizing the purposes of the present Invention differs from the previous one by that the substrate is formed by a polymer, providing effective absorption of non-fluorescent dimmers and other associates of the ionic pairs of cationic dyes on its boundary with the active layer, thus providing good adhesion of the active layer to the substrate. The substrate is covered with the active layer, containing a fluorescent dye, soluble in hydroxyl solvents of the film-forming polymer, a plasticizer and the add, which improves adhesion of the active layer to
10 the substrate.

Polyvinylchloride (PVC) and its co-polymers form the substrate.

The below examples illustrate this Invention, thus not limiting it.

Example 1.

15 The solution of 1% polyvinylacetate (PVA), 0.013% 3-Diethylamino-7-diethylaminophenoxazonium perchlorate (Ox-1) and 0.2% dioctylphthalatate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

20 Example 2.

The solution of 1% polyvinylacetate (PVA), 0.039% 3-Diethylamino-7-diethylaminophenoxazonium perchlorate (Ox-1) and 0.2% dioctylphthalatate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

25

Example 3.

The solution of 1% polyvinylacetate (PVA), 0.078% 3-Diethylamino-7-diethylaminophenoxazonium perchlorate (Ox-1) and 0.2% dioctylphthalatate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered
30 and deposited on the substrate.

Example 4.

The solution of 1% nitrocellulose (NC), 0.013% 3-Diethylamino-7-diethylaminophenoxazonium perchlorate (Ox-1) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 5.

The solution of 1% nitrocellulose (NC), 0.039% 3-Diethylamino-7-diethylaminophenoxazonium perchlorate (Ox-1) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 6.

The solution of 1% nitrocellulose (NC), 0.078% 3-Diethylamino-7-diethylaminophenoxazonium perchlorate (Ox-1) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 7.

The solution of 1% polyvinylacetate (PVA), 0.013% 1,1', 3,3,3', 3'-Hexamethylindodicarbocyanine iodide (HIDC) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 8.

The solution of 1% polyvinylacetate (PVA), 0.039% 1,1', 3,3,3', 3'-Hexamethylindodicarbocyanine iodide (HIDC) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 9.

The solution of 1% polyvinylacetate (PVA), 0.078% 1,1', 3,3,3', 3'-Hexamethylindodicarbocyanine iodide (HIDC) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for preparing the fluorescent composition. The solution was filtered
5 and deposited on the substrate.

Example 10.

The solution of 1% nitrocellulose (NC), 0.013% 1,1', 3,3,3', 3'-Hexamethylindodicarbocyanine iodide (HIDC) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for
10 preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 11.

The solution of 1% nitrocellulose (NC), 0.039% 1,1', 3,3,3', 3'-Hexamethylindodicarbocyanine iodide (HIDC) and 0.2% dioctylphthalate in ethanol and ethyl cellusolve (1:1) was used for
15 preparing the fluorescent composition. The solution was filtered and deposited on the substrate.

Example 12.

The solution of 1% polymethylmetacrilate (PMMA), 0.013% Oxazine 725 Perchlorate (Exciton, Inc.)(Ox-1) and 0.2% dioctylphthalate in methylenechloride and dioxane (1:4) was used for
20 preparing the fluorescent composition. The solution was filtered, deposited on a polycarbonate disc with a liquid silica glass sub-layer and dried.

Example 13.

The solution of 1% chlorine (PCV), 0.013% Oxazine 725 Perchlorate (Exciton, Inc.)(Ox-1) and
25 0.2% dioctylphthalate in methylenechloride and dioxane (1:4) was used for preparing the fluorescent composition. The solution was filtered, deposited on a polycarbonate disc with a liquid silica glass sub-layer and dried.

Effect of increasing of I_{fl} at exchanging PVC for NC

Ex. #		Dye concentration Mol/kg	Substrate type	Absorption				Fluorescence	
				D_1	D_2	D_2 / D_1	$\frac{1}{2}$	λ_{flour} (nm)	I_{fl}
1.	OX1+PVA	0.03	PC	0.034	0.014	0.41	14.3	668	0.530
2.	OX1+PVA	0.09	PC	0.078	0.040	0.51	15.1	668	0.367
3.	OX1+PVA	0.018	PC	0.161	0.103	0.64	18.1	671	0.318
4.	OX1+NC	0.03	PC	0.057	0.021	0.37	15.0	675	0.991
5.	OX1+NC	0.09	PC	0.122	0.048	0.39	13.2	674	0.581
6.	OX1+NC	0.018	PC	0.241	0.112	0.46	14.6	667	0.748

NB: Thickness of fluorescent layer is 150 nm

Table # 1

Effect of increasing of I_{fl} with use of primer

Ex. #	Dye concentration Mo1/kg	Primer (liquid glass ~80 nm)	Sub- strate type	Absorption				Fluorescence		Fluor. layer thick- ness	
				D ₁	D ₂	D ₂ / D ₁	½	λ _{fluor} , (nm)	Rel. I _{fl}		
1.	OX1+PVA	0.03	-	PC	0.034	0.014	0.41	14.3	668	0.530	150
1.	OX1+PVA	0.03	+	PC	0.035	0.017	0.48	15	674	0.367	150
13.	OX1+PMMA	0.03	+	PC	0.049	0.024	0.49	15,7	665	0.318	200
14.	OX1+PCV	0.03	+	PC	0.017	0.005	0.29	11,8	664	0.991	50

Table # 2

Dependence of I_{fl} level from the polymer substrate nature

Substrate type / Ex. # 1	Absorption			Fluorescence	
	D_1	D_2	D_2 / D_1	$\lambda_{fluor},$ (nm)	I_{fl}
Polypropylene	0.024	0.013	0.54	668	0.177
Polyester	0.015	0.007	0.47	665	0.206
Polycarbonate	0.031	0.014	0.46	664	0.425
Polyvinylchlorid e	0.035	0.018	0.45	660	4.145

NB: Thickness of fluorescent layer is 300 nm

Table # 3

Dependence of I_{fl} level from the fluorescent layer thickness on PVC (example # 1)

Substrate type / Ex. # 1	Fluor. layer thick	Absorption			Fluorescence	
		D_1	D_2	D_2/D_1	$1/2$	$I_{fl}^{rel.}$ $\lambda_{fl.}$ (nm)
PC	150	0.034	0.014	0.41	14.3	668 1.0
PVC	150	0.038	0.016	0.43	10.3	663 4.0
PVC	300	0.087	0.036	0.41	10.7	661 22.5
PVC	300	0.074	0.030	0.41	10.0	661 21.0

Table # 4

Dependence of I_{fl} level from the fluorescent layer thickness on PVC (examples ## 4 and 5)

Ex. #		Dye concentration Mol/kg	Fluor. layer thick- ness (nm)	Sub- strate type	Absorption			Fluorescence		
					D_1	D_2	D_2/D_1	λ_{fl} , nm	λ_{fl} , nm	I_{fl}
4	OX1+NC	$3 \cdot 10^{-2}$	200	PVC	0.044	0.034	0.76	12.2	663	4.478
4	OX1+NC	$3 \cdot 10^{-2}$	400	PVC	0.084	0.056	0.63	10.7	662	7.145
4	OX1+NC	$3 \cdot 10^{-2}$	500	PVC	0.147	0.081	0.55	10.7	661	13.25
5	OX1+NC	$9 \cdot 10^{-2}$	200	PVC	0.177	0.089	0.47	12.9	664	5.895
5	OX1+NC	$9 \cdot 10^{-2}$	400	PVC	0.416	0.14	0.38	10.7	667	14.7
5	OX1+NC	$9 \cdot 10^{-2}$	500	PVC	0.615	0.240	0.39	11.4	669	7.521

Table # 5

Dependence of I_{fl} level from the polymer nature and the fluorescent layer thickness (examples ## 7, 8, 10 and 11)
(examples ## 7, 8, 10 and 11)

Ex. #		Dye concentra- tion Mol/kg	Fluor. layer thick (nm)	Substrate type	Absorption			Fluorescence		
					D_1	D_2	D_2 / D_1	$\lambda_{flour,2}$ (nm)	$\lambda_{flour,1}$ (nm)	I_{fl}
10	HIDC+NC	$3 \cdot 10^{-2}$	200	PVC	0.110	0.066	0.06	673	15.0	5.640
10	HIDC+NC	$3 \cdot 10^{-2}$	400	PVC	0.219	0.106	0.48	674	13.6	8.032
7	HIDC+PVA	$3 \cdot 10^{-2}$	300	PC	0.196	0.120	0.61	665	17.9	0.378
11	HIDC+NC	$9 \cdot 10^{-2}$	200	PVC	0.296	0.148	0.50	674	13.9	3.797
11	HIDC+NC	$9 \cdot 10^{-2}$	400	PVC	0.662	0.092	0.44	678	14.3	11.53
8	HIDC+PVA	$9 \cdot 10^{-2}$	100	PC	0.146	0.07	0.50	672	15.7	0.228

Table # 6

Table 1 illustrates the effect of increasing fluorescence intensity by using a filmmaking polymer, which reduces the ability of cationic dyes to form non-fluorescent dimmers and other dyes associates. The table, as well as all the tables given below, utilizes the following designations:

- 5 D_1 - optical density of the monomer form in a maxima of absorption;
- D_2 - optical density of associated forms in a maxima of absorption;
- D_2/D_1 - the ratio, describing the ability of the dyes to form associates;
- $l/2$ - half-width of the absorption band on the 0.7 D_1 level, describing heterogeneity of the absorption band due to the formation of associates and by-products of the specific reaction
- 10 between the dyes and the medium;
- $\lambda\lambda_{\max}$ – maximum of fluorescence;
- I_f – intensity of fluorescence in relative figures.

As can be seen from Table 1, the increase of Ox-1 concentration causes I_f reduction both in PVA and nitrocellulose, thus increasing of D_2/D_1 and $l/2$. In case of exchanging PVA

15 for the nitrocellulose, the total I_f level doubles due to decreased ability of the Ox-1 to form the associates.

Table 2 illustrates the effect of increasing fluorescence intensity by using a primer between the substrate and the active layer, which allows depositing the fluorescent

20 compositions containing solvents, aggressive to the substrate.] Plotting of a liquid silica glass primer 80 nm thick on a PC substrate allows depositing compositions based on PMMA and PVC, containing methylenechloride and dioxane, which also solves the PC substrate.

As can be seen from the Table 2, in the Examples 13 and 14 the fluorescence level

25 increases in 6 and 8 times correspondingly in comparison to the example without the primer (Example 1). Use of primer doubles fluorescence in the Example 1 composition.

Table 3 illustrates the impact of the polymer substrate nature on the fluorescence intensity in the Example 1. The types of substrates are sorted by ascending of fluorescence.

30 As seen, the transition from polypropylene to polyvinylchloride consecutively increases fluorescence, which is maximum for the polyvinylchloride. The consequence for the adhesion of the active layer to the substrate is the same.

The non-cymbate growth of fluorescent signal at increasing the active layer thickness without changing the dye concentration, as shown in the Table 4 with respect to the polymer, testifies that the associated forms of the dye are mostly absorbed on the boundary of the substrate (PCV, in this case) and the active layer. At the same time, the monomeric form of the dye is mostly diluted in the polymeric composition. Due to the same reasons, increasing dye concentration in the active layer bonded on the PVC does not cause depreciation of fluorescence, as in the case of using PC substrate. In some case, we observe even the growth of I_{fl} (compare Tables 5, 6 and 1).

Thus, the proposed ways of increasing fluorescence or the polymeric compositions, containing super-high concentrations of the fluorescent dyes ($3-20 \times 10^{-2}$ Mol/kg of polymer), which usually cause rigid deprecation of fluorescence, can be used for creation of optical recording media for low-cost CD ROM, DVD and WORM discs with simplified structure and with increased quality and stability of data reproduction at reading by fluorescence.

The greatest strengthening of the fluorescent signal is achieved by using primers (2-8 times increase) and polymer substrate, providing effective absorption of the non-fluorescent associates of the dye molecules on its boundary with the active layer (more than 20 times increase).

WHAT IS CLAIMED IS:

1 1. Fluorescent composition for manufacturing single- and multilayer optical discs of CD
2 ROM, DVD and WORM types with fluorescent reading, comprising:

- 3 - fluorescent dye,
4 - film-forming polymer,
5 - plasticizer, and, if necessary,
6 - surfactant, and
7 - light stabilizer.

1 2. Fluorescent composition of claim 1, distinguished by choosing the fluorescent dye
2 among xanthene dyes of the eosine and rhodamine groups, acridine, oxazine, azine,
3 perylene, violanthrole, cyanine, phthalocyanine dyes, indigoid colors and porphyrines.
4 Content of the fluorescent dye in the layer is 0.1-10%.

1 3. Fluorescent composition of claim 1, distinguished by choosing the film-making
2 polymer among the resins, including cellulose esters, such as nitrocellulose, cellulose
3 acetate, cellulose acetate butyrate; cellulose ethers such as methyl cellulose, ethyl
4 cellulose, butyl cellulose; vinyl resins such as polyvinyl acetate, polyvinyl butyral,
5 polyvinyl acetal, polyvinyl alcohol and polyvinyl pyrrolidone; acrylic resins such as
6 polymethylmethacrylate, polybutyl acrylate, polymethacrylic acid, polyacrylic acid and
7 polyacrylonitrile and their mixture.

1 4. Fluorescent composition of claim 1, distinguished by choosing the plasticizer among
2 phthalates (dibutyl phthalate, dioctyl phthalate and al) and phosphates (triphenylphosphate,
3 tricresylphosphate and al). Content of the plasticizer in the layer is 10-50%.

1 5. Method of producing the optical disc by solvating the compounds of claim 1 in an
2 organic solvent chosen among alcohols, ketones, amides, sulfoxides, ethers, esters,
3 halogenated aliphatic hydrocarbons or aromatic solvents, then dispersing the received
4 composition by spin coating, roller coating or dip coating on a substrate, which is a
5 polycarbonate or polyethylene terephthalate disc, or on a primer.

1 6. Method of increasing the fluorescent signal from optical discs by placing a primer 10-
2 100 nm thick between the substrate and the active layer, which prevents the substrate
3 from aggressive impact of the solvents belonging to the fluorescent composition.

1 7. Method of increasing the fluorescent signal level, distinguished by use of liquid silica
2 glass, Colcoat N-103X product by Colcoat Co., Ltd., polyvinyl alcohol, heat treated after
3 depositing on the substrate, thermosetting resins, including epoxy, phenol-, urea- and
4 melamine-formaldehyde resins, polyorganosiloxanes, as well as latexes – divinyl styrene,
5 divinylonitrile, styrene acrylate, alkyd, acrylate, etc. for producing the primer.

1 8. Method of increasing the fluorescent signal level, distinguished by use of different
2 surface-active substances, such as butyl glycol, propylene glycol, dimethyl glycol, diethyl
3 glycol, etc., as well as by heating the material at 100-120°C for improving adhesion of the
4 active layers to the substrate or the primer.

1 9. Method of increasing the fluorescent signal level, distinguished by making a substrate
2 from the polymer, providing effective absorption of non-fluorescent associates on its
3 boundary with the active layer, as well as good adhesion of the active layer to the
4 substrate.

1 10. Method of increasing the fluorescent signal level according to item 9 distinguished by
2 use of polyvinylchloride and its co-polymers as the substrate.

ABSTRACT OF THE DISCLOSURE

A fluorescent composition for use with single-layer and multilayer optical discs for CD ROM, DVD and WORM type devices with fluorescent reading is disclosed. The composition comprises a fluorescent dye, film-forming polymer, plasticizer, surfactant and light stabilizer. A method of increasing fluorescent signal level from the optical discs both for single-layer and multilayer optical memory materials is also disclosed along with the resulting optical discs.